NOTES ON *ARCTIIDAE*.

BY DR. KARL JORDAN.

(With 47 Text-figures.)

IN the taxonomy of species colour and pattern have played a more important part in Lepidoptera than in other orders of insects. In many genera of Lepidoptera, however, the pattern has remained so uniform or has become so simplified or so unified that colour distinctions between the species are more or less absent, the species being so similar to one another that they are not, or not easily, distinguished without an investigation of their structure (*congeneric synchromatic species*). On the other hand, there are species and groups of species in which colour and pattern, and often also the shape of the wings and the size, are so variable individually that none of these external distinctions are trustworthy guides in differentiating the species. These extremes offer a most interesting field for research. They not only have many surprises in store for the systematist, but also are of considerable importance for the study of the wider question of evolution.

Instances of both these extremes are not rare among the **Arctiidae**, and Lord Rothschild has drawn my attention to quite a number of species which he thought might possibly be composite. In offering herewith some notes on a few American congeneric synchromatic Arctiids I confine my remarks in the body of the paper almost exclusively to the systematics of the species with which I am dealing, but venture to mention at the end of the paper a few points of general interest of which the Arctiids here described may be regarded as illustrations.

GENUS **Ammalo** Walk. (1855)

In Hampson, *Lep. Phal.* iii. p. 83 (1901), the genus *Ammalo* contains six species, one of which is *insulata* Walk. (1855). This is a small species (length of forewing 13 to 22 mm.), with a buff-yellow abdomen which bears black dorsal and lateral spots or dots, the thorax and wings varying from cream-colour to buff-yellow, and the antennae, palpi, lower part of the frons and the tibiae and tarsi being more or less blackish brown. It is a very uniformly coloured insect.

An examination of the specimens in the Tring Museum (about 150) and of the series in the British Museum has produced convincing evidence that there are three such yellow species instead of one. Apart from one of them having the frons rather more extended blackish brown than the others (the difference being measurable under a lens), these species are alike in colour, but perfectly distinct in structure in both sexes.

The species commonest in collections is

1. **Ammalo insulata** Walk. (1855)

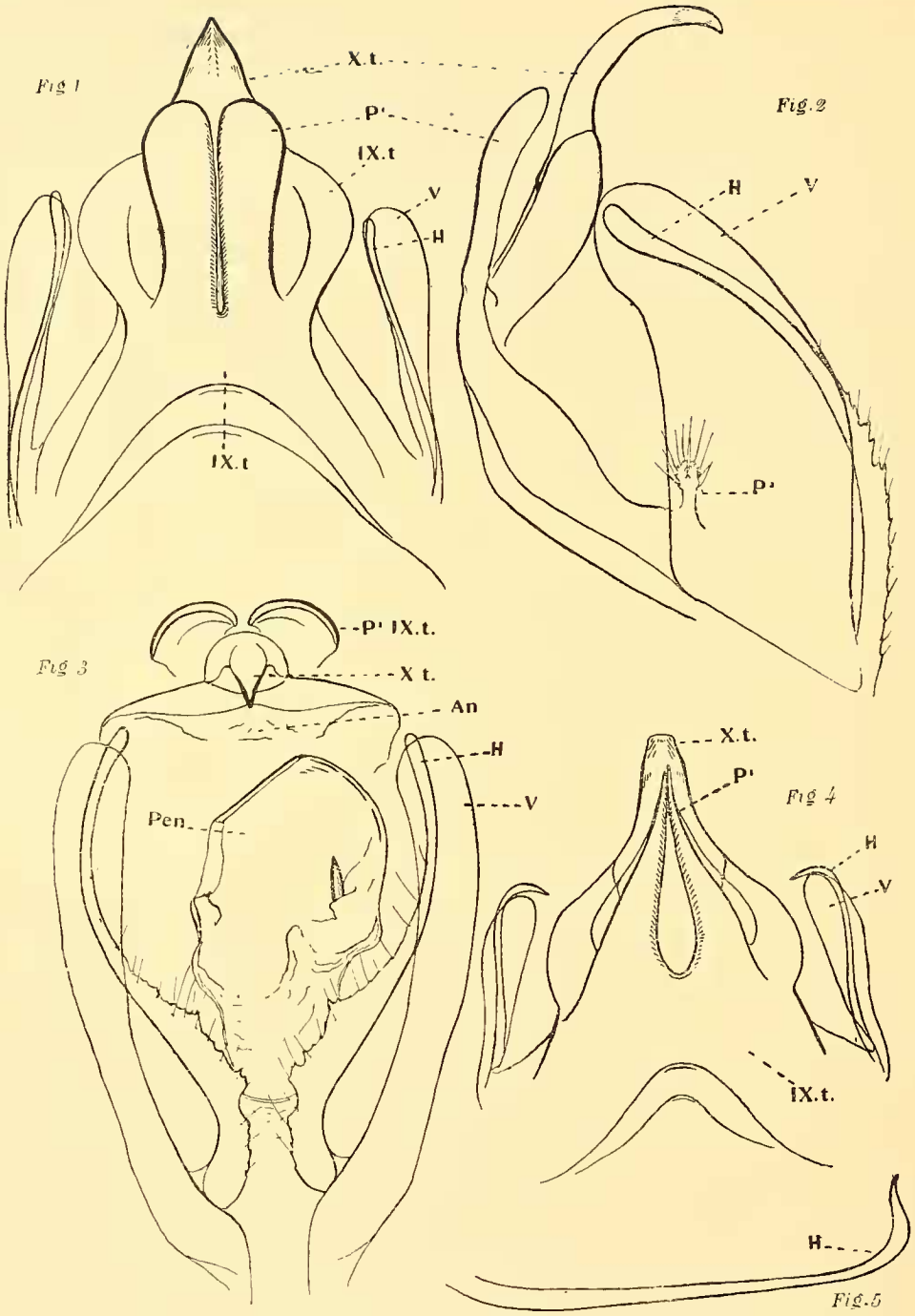
Originally described from Jamaica, this species is known also from the other larger West Indian islands as well as the Bahamas, Grand Cayman, Grenada and Florida, and probably occurs on most of the islands; on the continent it is found from Mexico to Colombia, its range extending eastwards to British Guiana, and

including Venezuela and Trinidad. There is also a pair in the Tring Museum labelled Rio de Janeiro, and another ♀ ticketed "Brazil," but it is perhaps advisable to await confirmation of this record before accepting it as correct. Anyhow, *A. insulata* is an essentially Caribbean species. The ranges of the other species are much more restricted.

In colour *insulata* varies from cream-colour to buff-yellow. The black suffusion of the frons is restricted to the lower third, and is sometimes vestigial only. The pectinations of the central segments of the antenna are in the ♂ about as long as the shaft of two segments. The main distinctions are found in the genitalia, which are built up on the same plan in all three species, but exhibit very striking differences in the detail. The supra-anal hook, which is morphologically the tenth tergite, and is usually termed the *uncus* in descriptive Lepidopterology, is nearly always visible without dissection. But in order to get a clear view of the other sclerites it is necessary to remove the eighth segment, or at least that apical portion of it which projects over the following segments, forming a sort of cylinder or cavity into which the organs of copulation are retracted. When the eighth tergite has been made somewhat flexible by a little wood-naphtha or weak alcohol, a sharp longitudinal cut at one side and a cut across the back usually enables one to lift the integument up and bend it towards one side without breaking it altogether, leaving the ninth and tenth segments exposed to view.

The ninth tergite is dorsally produced into a pair of long processes (P^1 in our text-figures), which are hollow, bear long stiff scales usually pasted together, and contain probably scent-glands. The processes project over the widened and centrally-flattened apical portion of the ninth tergite and overlap the base of the tenth tergite (or uncus). In *insulata* (text-figs. 1 and 2, P^1) they are three times as long as they are broad, being widened distally on the outer sides with the apex rounded off. The pleurite of the ninth segment forms the side-clasper, consisting of the valve (V) and the harpe (H). The valve (text-figs. 1, 2, 3, V) is thin, i.e. weakly chitinised, and evidently serves more as a cover than as an organ of prehension. Its shape in *A. insulata* is represented in text-fig. 2, the real outline being distorted in a view from above (text-fig. 1), and from below (text-fig. 3). The harpe (H) is detached from the valve, except at the base. It is as long as the clasper in *insulata*, slender, with the apex rounded and more or less widened, the proximal portion of the ventral margin being irregularly notched (cf. text-figs. 2 and 3). On the ventral, membranaceous or semi-membranaceous, portion of the ninth tergite, inside of the clasper towards the penis-sheath, there is on each side a short, soft, club-shaped process (P^2) studded at the apex with long bristles (text-fig. 2). This organ, which recurs in various shapes throughout the family, though not everywhere, is apparently of a sensory nature. The tenth tergite (x. t.) of these species is a simple process, widest at the base, more or less convex above, and gradually curved downwards, its under surface being concave. In *insulata* the apex is sharply pointed and subcarinate above. There is no separate, projecting sclerite below the anus homologous with the tenth sternite, this sternite simply forming part of the integument extending between the penis-sheath and the anus. The penis-sheath (Pen) is very large in all three species, and internally armed with one strongly chitinised spiniform love-dagger.

In the **female** the differences most easily seen are those presented by the eighth sternite, which lies behind the orifice of the vagina (Vg) and in front of the anal segment (which is formed by segments ix and x being completely fused). In



TEXT-FIG. 1.—*Ammalo insulata.*
„ „ 2.— „ „
„ „ 3.— „ „
„ „ 4.— „ *arravaca.*
„ „ 5.— „ „

insulata the centre of sternite viii is always swollen, a transverse glossy callosity being formed which is more or less hidden by the overlapping sternite vii (text-fig. 8).

The ♂-genitalia vary very slightly geographically.

2. **Ammalo arravaca** spec. nov. (text-figs. 4, 5, 9)

This species is only known to me from French Guiana and Surinam, all the specimens I have seen from these countries belonging to *arravaca*. The pair recorded by Lord Rothschild under *insulata* (*Nov. Zool.* 1910, p. 35) from "Brazil (Meyer coll.)" is *arravaca*, and the locality Brazil may safely be regarded as erroneous.

A. arravaca agrees in colour with *insulata*, but our specimens are on an average smaller, the forewing measuring from 14 to 16 mm. in length; this measurement may not be confirmed, if a series larger in number than ours is compared.

The pectinations of the male antenna are very slightly longer than in *insulata*. The dorsal processes of the ninth tergite (text-fig. 4, P^1) are pointed, tapering from the base to the apex, the slit between them being much wider than in *insulata*. The valve (V) is practically the same as in that species, but the harpe (H) is strongly curved at the apex, ending in a sharp point, which often projects beyond the apex of the clasper (text-fig. 5). The tenth tergite is rounded-truncate (x. t.), not pointed as in the other species, and apically flattened. As this organ usually projects from beneath the eighth segment, and can easily be examined, there is no difficulty in distinguishing the ♂ of *arravaca* from the other species.

The eighth sternite of the female (text-fig. 9) differs from that of *insulata* in bearing no large median callosity. The apical margin is not incrassate in the centre, or only to a very slight degree. The feeble swelling which is usually present, and which extends forward as an indistinct median ridge, is more due to the segment being slightly folded along the centre than to being actually swollen. If the ridge or fold is distinct, the apical margin of the segment bears a small central notch. This margin is distinctly visible in most specimens without the scaling being touched. If it is concealed the scaling should be lifted up or brushed sideways.

We have a series of both sexes from St. Jean du Maroni (type) and St. Laurent du Maroni, French Guiana (E. Le Moult), and Aroewarwa Creek, Maroewym Valley, Surinam (S. M. Klages). The type is labelled September, and Mr. Klages found his specimens in April and May.

3. **Ammalo aurata** Butl. (1875) (text-figs. 6, 7, 10)

The specimens from South-East Brazil are deep buff-yellow, but similarly coloured examples occur also among *A. insulata*. The deep colouring was the only difference which Butler noted when describing *aurata* from a single Brazilian female from Espiritu Santo. It was a shot in the dark, but nevertheless a hit. *A. aurata* occurs on the Lower Amazons and in South-East Brazil. A female in the Tring Museum bears the locality label "La Merced, Chanchamayo." The specimen, however, was not received direct from the collector, and as we have not seen any other specimens of *aurata* or of *insulata* from the Andes countries of South America apart from Colombia, the before-mentioned female probably did not come from Peru, but from the eastern side of the continent. I consider *aurata* a Brazilian species which has extended its range into the Amazon valley (Pará, Manáos), and in the south is found as far west as Tucuman and Paraguay.

While in the two previous species about one-third of the frons is blackish, this colour extends in *aurata* to one-half. This distinction appears to be somewhat more reliable than the difference in the yellow coloration of the wings above referred to. The pectinations of the male antenna are decidedly longer than in the

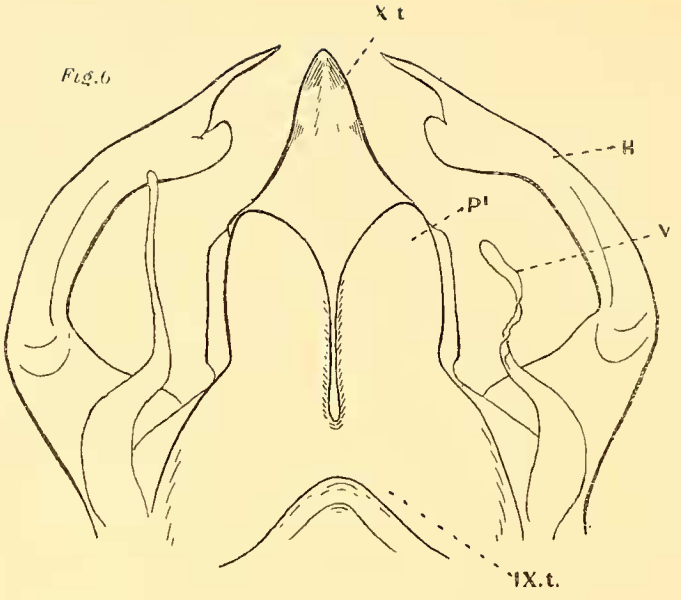


Fig. 6

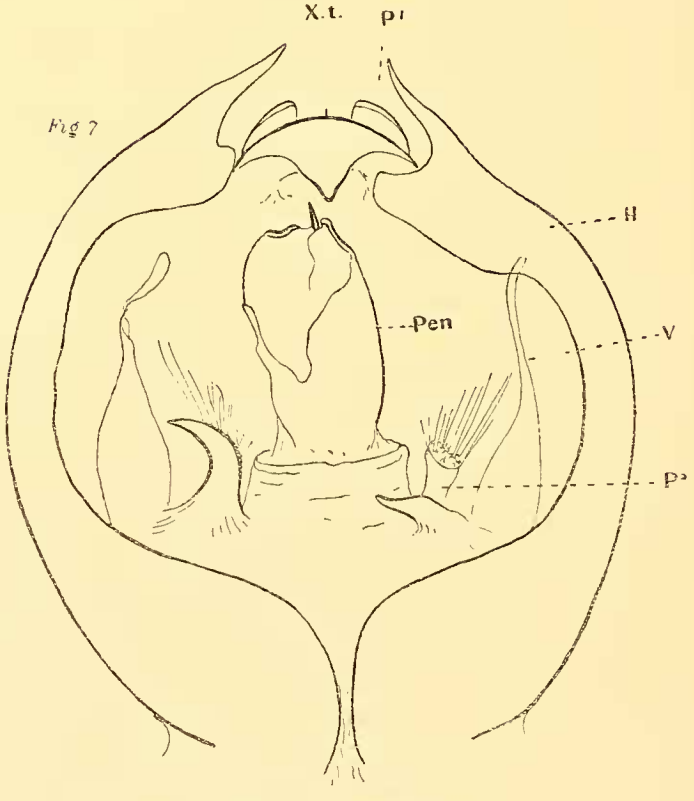
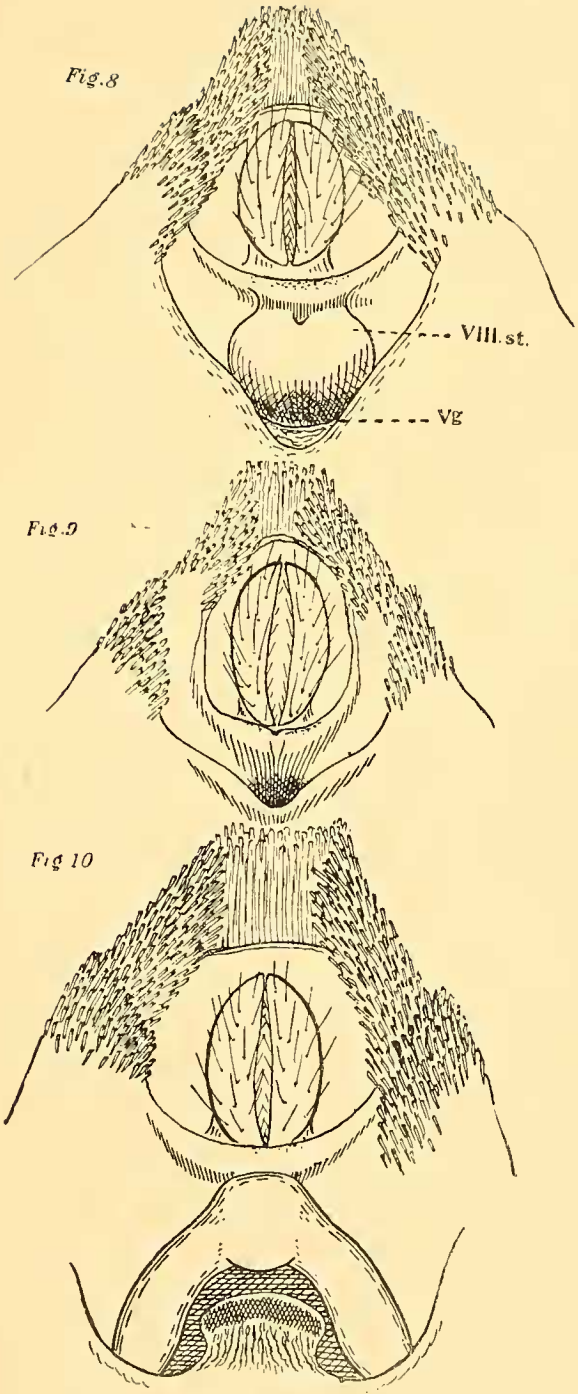


Fig 7

TEXT-FIG. 6.—*Ammalo aurata.*
„ „ 7.— „ „

previous species, those of the central segments being about as long as the shaft of three segments. The difference in the female antenna is less evident, but quite appreciable under the microscope. The length of the forewing varies as much as in *A. insulata.*

The dorsal processes of the ninth tergite of the **male** (text-fig. 6, P, dorsal view) are much shorter and much broader than in *A. insulata*, and apically more tapering on the inner side than on the outer. The valve (V) is reduced to a narrow and weak strip, presumably without function, but covered with scaling, as is the case with the valve of the other species. The harpe (H), on the other hand, is very strongly developed, being much larger than in *insulata* and *arravaca*. Its shape is also quite different, the apex being divided into a sharply pointed dorsal prong and an obtuse ventral lobe. These apical projections are not quite the same on the two sides of the body, and also vary in the different individuals. The harpes are so long that their apices are nearly always visible without the scaling being brushed aside. The tenth tergite is pointed, as in *A. insulata*. A ventral view of the organs of copulation (text-fig. 7) reveals another distinction of *aurata*. Below the short funnel from which the penis-sheath (Pen) projects we find on each side a strongly chitinised short process not present in the other species. The processes are not alike, the left one being much larger and more regularly curved and pointed than the one of the right-hand side. The tips of both are directed towards the left side. Above them we find the setiferous claviform processes (P^2) already mentioned under *A. insulata*.



Text-fig. 8.—*Ammalo insulata.*
„ „ 9.— „ *arravaca.*
„ „ 10.— „ *aurata.*

The structure of the eighth sternite of the **female** (text-fig. 10) is very distinctive. A semicrescent-shaped, smooth, convex rim is formed around the orifice of the vagina, this wall being widened centrally, the widened portion corresponding

to the callosity described under *A. insulata*. The seventh sternite projects into the cavity, the projection being broad, smooth and glossy, with the proximal portion longitudinally wrinkled.

The distribution of the three species suggests that they have attained their distinctions by means of geographical isolation and the attending differences in the surroundings. The most widely distributed species, *insulata*, is morphologically the central one, its characteristics agreeing more or less with those which I am inclined to attribute to the common ancestor.

Ammalo helops Cram. (1775) is another species of wide distribution according to Hampson, l.c., p. 83. I find it to be a composite species, which I hope to discuss on another occasion. *A. helops* is nearly allied to some species placed under *Elysius*. One of the main distinctions between *Elysius* and *Ammalo* in Hampson's *Lep. Phal.* is the difference in the position of the second subcostal branch of the forewing, this vein being said to arise from the cell in *Elysius* and beyond it in *Ammalo*. We have, however, a number of specimens of *Ammalo helops* in which this vein branches off from the cell.

GENUS **Sychesia** Möschl. (1877)

In Hampson, l.c., p. 106, the first section of *Elysius* is characterised as follows: "Sect. I. (*Sychesia*). Antennae of male with long branches; hindwing with vein 8 absent." One species is placed in this section, *Elysius dryas* Cram. (1775). As this "*dryas*," however, is not a solitary species, but represents a type to which quite a number of species conform, there is sufficient reason for reviving *Sychesia* as a genus separate from *Elysius*.

The species of *Sychesia* resemble one another very closely in colour. If in the figure of *S. omissus*, in *Nov. Zool.* xvii. pl. 13, fig. 15, the black-brown colour were paler, and the orange of the abdomen and hindwing less bright, the figure might be considered a fairly accurate representation of several other species. There are some colour-differences in the various species, but they are as a rule so vague that a correct determination of the species from mere coloured figures appears to me impossible without recourse to the structure of the tail-ends. In several species there is a conspicuous scarlet tint on the abdomen and collar, but not in all specimens, and this colour may also appear in species which are usually without it. The length of the pectinations of the male antennae is not the same throughout the genus, the males of *omissus*, for instance, being easily distinguished by the short pectinations, and *subtilis* separated from *dryas* by the long pectinations. There are, however, other species which cannot be differentiated by the length of the pectinations from *dryas* or from *subtilis*. The structure of the tail-end of the male is rather complicated on account of the many processes and lobes of which the prehensile organs are composed. A clear view of them is only obtained on removal of the eighth segment; but for the purpose of identification this is hardly ever necessary, the apices of at least some of the processes being visible if the scaling at the tip of the abdomen is partially removed or brushed aside. The commonest of the species is fortunately not difficult to recognise, and therefore may with advantage serve as a starting-point in the determination of the series of species.

1. Sychesia dryas Cram. (1775) (text-figs. 11–15, 41)

In Cramer's figure the hindwing is blue-grey instead of yellow.* No such species is known ; but as the figure is otherwise a fairly good representation of a male of *Sychesia*, considering the time of publication, we assume with Hampson that the colouring of the hindwing is due to some error. The specimen is said to have come from the West Indies, which geographical term at that time included Surinam.

We have three species from Surinam, obtained by Klages in the same locality on clearings in the forest, at night only. These are *subtilis* Butl. (1878), *omissus* Roths. (1910), and a third species which we treat, rightly or wrongly, as being *dryas* Cram. (1775). The name *fimbria* Möschl. (1877) apparently applies to *dryas*. The figure of *fimbria* is a misrepresentation, the head being much too small, the colouring of the thorax and forewing much too red, and the marginal band of the hindwing much too sharply defined and too narrow.

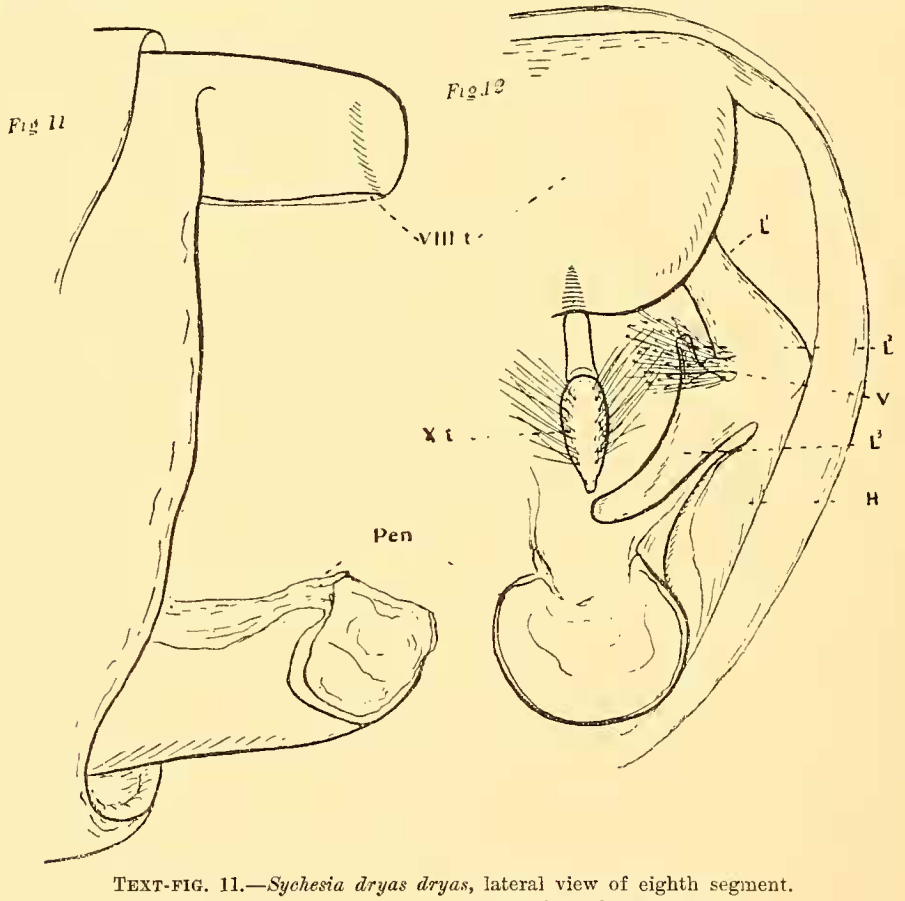
S. dryas is known to me from Surinam, the Caura R. in Venezuela, several places on the Upper Amazons, East and South-East Peru, East Bolivia, and South-East Brazil. In spite of this wide distribution there is no appreciable variation in the organs of copulation, with the exception of our only Brazilian male. The colour of the upperside of the forewing, head and thorax is mummy-brown in the darkest (freshest ?) specimens, and a light tint of raw umber in the palest (faded ?) examples. The collar has usually a rufous tint, but there is no red colouring noticeable at the base of the abdomen in any of our specimens. The density of the pale irroration of the forewing and the size of the pale discocellular spot are variable, as is also the width of the marginal border of the hindwing. In the male this border is usually separated from the apex of cell by the very pale yellow ground-colour or patches of it, but sometimes extends into the cell. In the female the border reaches always into the apex of the cell and usually expands to the base of the lower median vein, the angle between this vein and the cell remaining yellow in many specimens ; on the underside the yellow area is still more restricted, either entering the cell or being bounded in front by the cell and the lower median vein; in the latter case the patch is rounded distally, the fuscous marginal band reaching to the anal angle and extending a little along the abdominal margin, as it often also does on the upperside.

The structure of the last three abdominal segments of the **male** is very characteristic. The last external scaled segment is the eighth. It is black, as in the other species, but quite different in the structure of its central dorsal portion. This difference is easy to see in most examples. When inspected from the anal side the apical margin of the eighth tergite will be found to be clothed with black scaling on the upperside and yellow scaling on the underside.

Compared with any of the other species, the central marginal area of this tergite is thicker and projects anad, being separated at each side from the lateral portion of the segment by a notch. If the scaling is removed the explanation of this difference between *dryas* and the other species becomes at once evident. The segment is centrally produced in *dryas* into a short broad process, which is very slightly impressed centrally, convex above and at the margins, and hollow, membraneous and longitudinally folded beneath. The corresponding portion of the eighth tergite of the other species of the genus is but slightly produced and much less thickened than in *S. dryas* (cf. text-fig. 25, viii. t.). This process, of which

* Cramer's original drawings are in the British Museum ; in the drawing of *dryas* the hindwing is less uniformly blue and the black border less sharply defined than in the published figure.

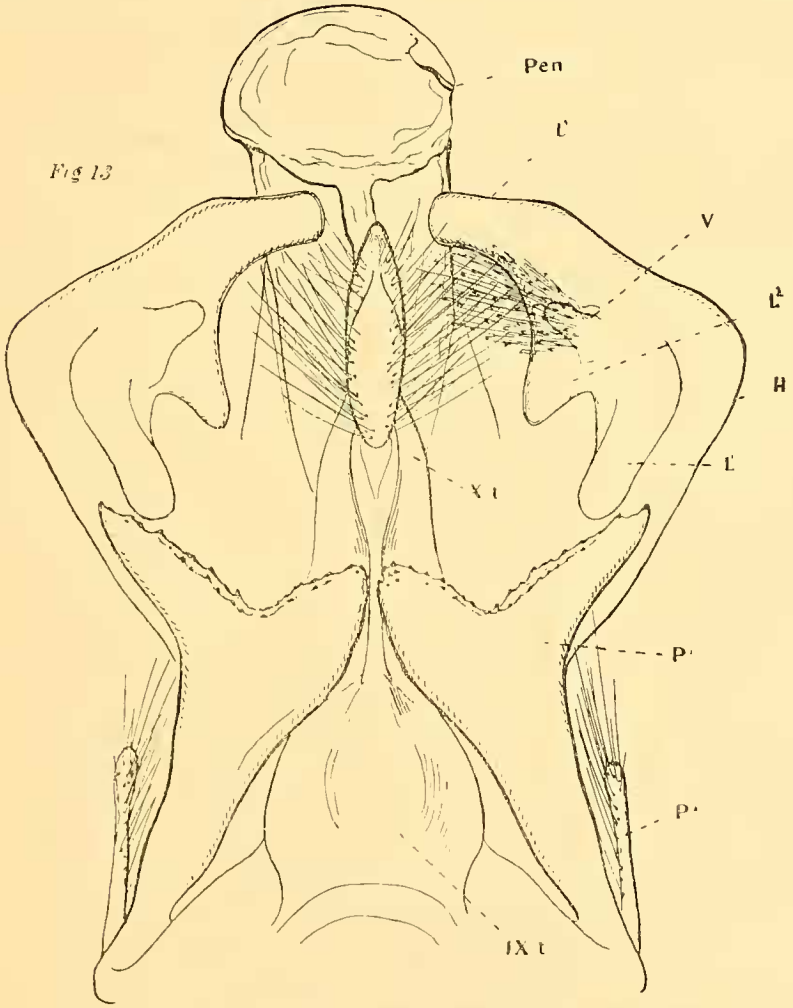
text-fig. 11 gives a lateral view, while in text-fig. 12 we look at it from the anal side and slightly from above, conceals the ninth tergite and its appendages, and must be removed if one wishes to study the latter in toto. Text-fig. 13 represents a dorsal view of the organs. From the lateral portion of the ninth tergite project on each side two processes. The upper one (P^1) is large, strongly chitinised and apically divided into two lobes, somewhat resembling a fishtail. The lobes are denticulate at the distal margin, the outer lobe being much longer than the inner one. The second process (P^2) is subcylindrical, weak, and bears numerous bristles. Below these processes long silky hairs are found, which are probably spreading hairs



TEXT-FIG. 11.—*Sychesia dryas dryas*, lateral view of eighth segment.
„ „ 12.— „ „ „ anal view of last segments.

of scent. The lateral clasping organ, the side-clasper, differs in true *dryas* and the Brazilian subspecies in the development of the apical processes of the harpe (H). We describe first the more widely distributed *S. dryas dryas*; in the anal view of the tail-end (text-fig. 12), three processes are visible at each side between the projection of the eighth tergite and the penis-sheath (Pen). These belong to the strongly developed harpe (H). The dorsal process L^1 is glossy, smooth and pale, being often partly concealed by the ninth tergite, as in our figure. The second process L^2 is situated on the proximal side; it is small and not easily seen; on the other hand, L^3 is very conspicuous, being very strongly chitinised, deep brown, and so much bent downwards that it usually lies on top of the penis-funnel (Pen). Between L^1 and L^3, on the outer side, there is a small weakly chitinised lobe bearing

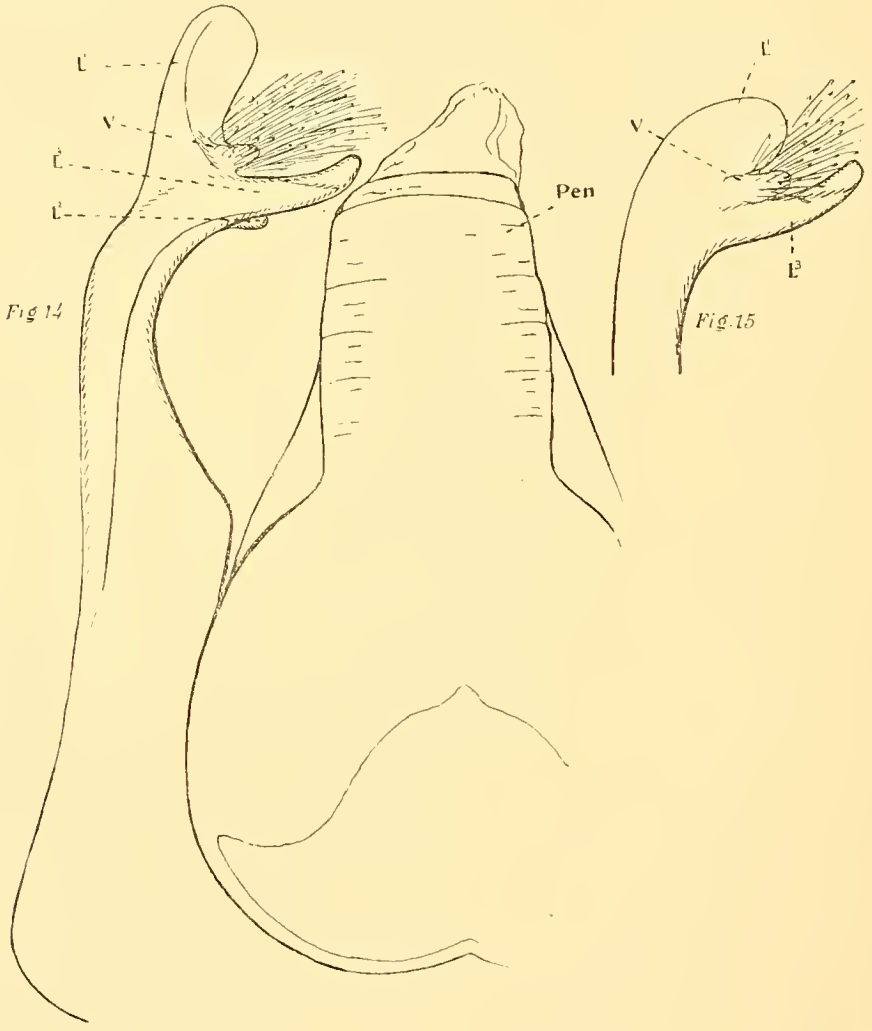
long scales. This lobe (V) is the remnant of the valve. We shall find the valve more normally developed in other species of *Sychesia*. The shape of the processes L^1, L^2, and L^3 is, of course, different according to the direction from which they are inspected; cf. text-fig. 13, a dorsal view. The harpe is visible in its entire length if examined from the ventral side (text-fig. 14). In the Brazilian form of *dryas* (text-fig. 15) process L^2 is absent, and L^1 is bent towards the middle plane of the body instead of pointing upwards, and rounded. The tenth tergite is long and



TEXT-FIG. 13.—*Sychesia dryas dryas*, dorsal view of last segments.

slender, being bent down at the base and then curved upwards, the apex forming a sort of head and beak. The ninth and tenth tergites together, in a side-view, resemble to some extent a swimming bird, the former representing the body. The slightly widened head of the tenth tergite bears numerous bristles, as in the other species of this genus. The penis-funnel (Pen) has the shape of a flagon, the neck being more or less wrinkled transversely: the upperside of the penis-funnel is membraneous, and open along the centre. The penis-sheath, which projects from it, has no external armature, nor does it seem to have an internal armature in any of the species (text-figs. 12, 13, 16).

The **female** armature is very simple. The eighth segment, which is covered by the seventh, is strongly chitinised in all the species, non-scaled, glossy, deep brown, both the dorsal plate and the ventral one. The latter bears the distinctive characters, which are slight, but appear to hold good. In *dryas* the eighth sternite (text-fig. 41) has a smooth edge, which is slightly incrassate in the centre, the corners of the plate being either somewhat acuminate or rounded, not bearing a distinct tooth.



TEXT-FIG. 14.—*Sychesia dryas dryas*, ventral view.
„ „ 15.— „ „ *tupus*, „ „

According to the genital armature of the **male**, *S. dryas* consists of two subspecies :

a. *S. dryas dryas* Cram. (1775) (text-figs. 11–14, 41)

Harpe of ♂ with three apical lobes, the upper one compressed, pale, and polished, directed upwards.

French Guiana, Surinam, Caura River (southern affluent of the Orinoco), Upper Amazons, Peru and Bolivia.

b. *S. dryas tupus* subsp. nov. (text-fig. 15)

Harpe of ♂ with two apical processes, the upper one rounded and curved inward. The eighth sternite of the ♀ as in *S. d. dryas*.

Santa Catharina; one pair in the Tring Museum.

Halesidota basipennis Walk. (1856), from Pará, was based on a single female, now in the Oxford Museum. Dr. H. Eltringham, who has very kindly examined it for me, informs me that the edge of the eighth sternite is quite smooth. This would prove that the specimen belongs to *dryas*, and not to *subtilis* as I suspected from the locality. The females of *S. dryas tupus* and *S. dryas dryas* not being different, it is, of course, not possible to decide whether *basipennis*, from Pará, is the same as subsp. *tupus* or as subsp. *dryas*, or whether it represents a special subspecies from the Lower Amazon. To settle this point we must wait for the arrival of males. The Rev. A. Miles Moss having been stationed at Pará now for several years, this keen and successful lepidopterist will no doubt obtain a series of *S. dryas* in that most interesting district.

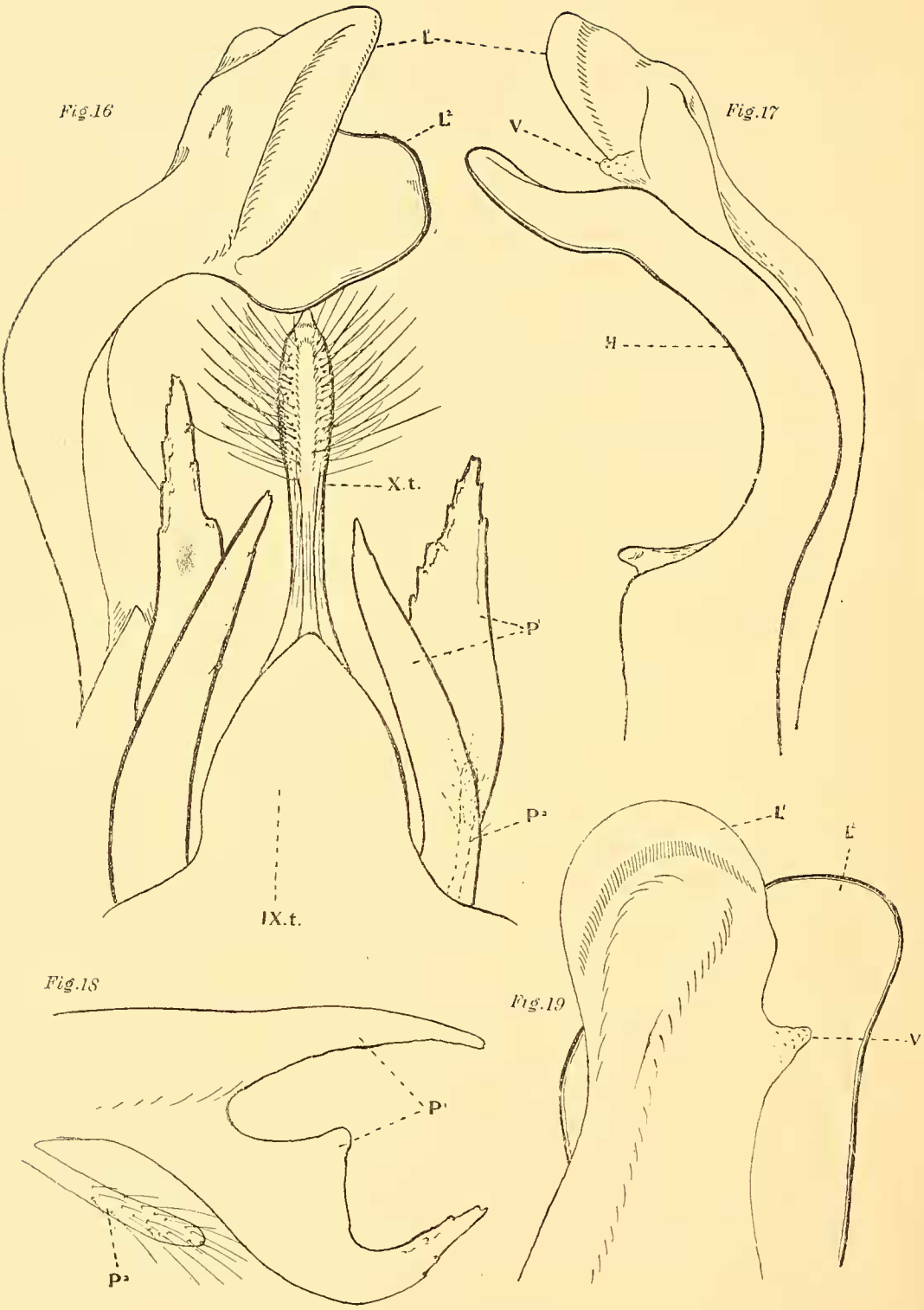
2. **Sychesia hora** spec. nov. (text-figs. 16–19)

The abdomen and hindwing perhaps a little deeper yellow than in *S. dryas*, otherwise the colouring the same as in certain specimens of that species. The black-brown border of the hindwing rather sharply defined in both sexes, in the male (we have only one specimen of this sex) not reaching the apex of the cell, and in the female (of which sex we have two specimens) extending to the point of origin of the upper median branch (vein 3).

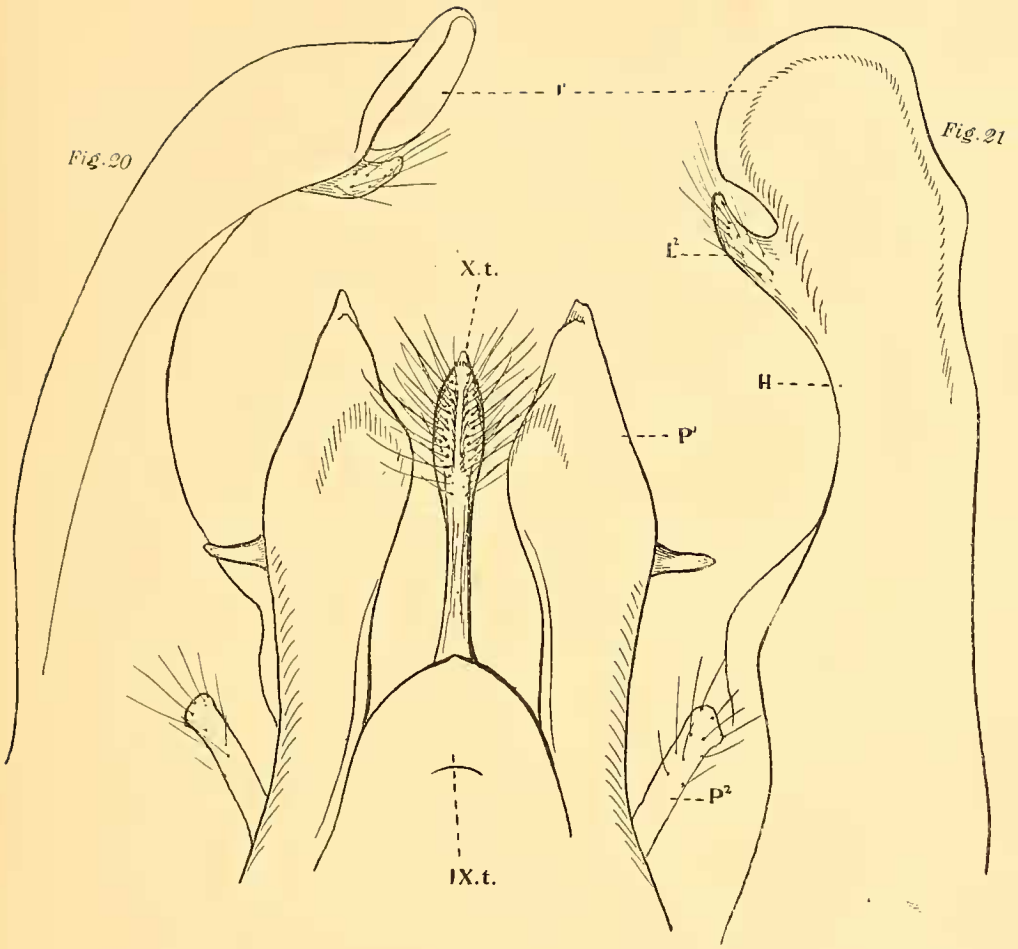
The median projection of the eighth tergite of the **male** resembles that of the preceding species, but is shorter and vertically thinner. The process P^1 of the ninth tergite (text-fig. 16) is large, compressed and apically divided into two large prongs, of which the lower one is curved and bears a large tooth on the upperside, as shown in the lateral view represented by text-fig. 18. From the base of this process P^1, on the underside, projects the pale, slender, setiferous process P^2, not visible in a dorsal view of the organs. The side-claspers are strongly developed, and very different from those of *S. dryas*, although built on the same plan. The thin apical lobe of the valve (text-fig. 17, V, ventral aspect) is reduced to a small tubercle, densely covered with scales. The harpe (H) consists of a more deeply chitinised inner portion ending in a very broad lobe, L^2, and bearing proximally to the middle a tooth, and a pale, glossy and smooth outer portion also ending in a broad lobe, L^1. The harpe is much broader centrally than it appears to be from our text-figs. 16 and 17, which represent it in a dorsal and ventral aspect; the lateral aspect is given in text-fig. 19. The tenth tergite (x.t.) is similar to that of *S. dryas*; the apex is grooved above. In spite of all the differences, the similarity between the organs of *S. dryas* and *hora* can easily be perceived.

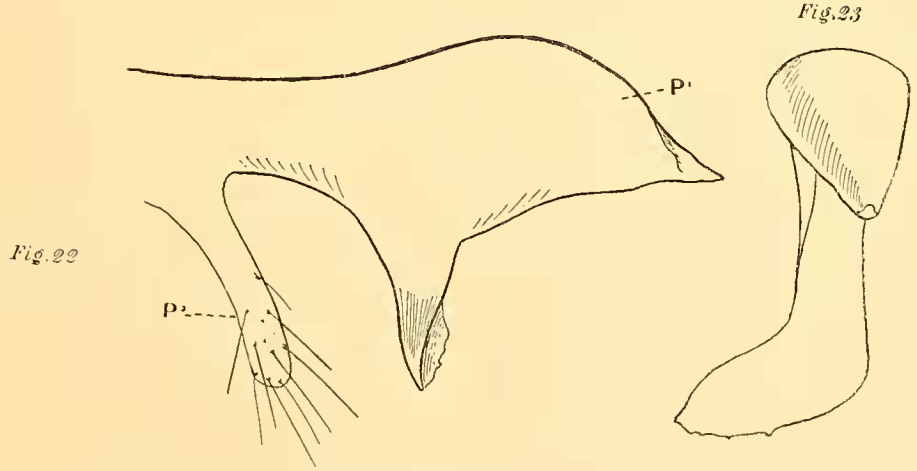
One male from Cananche, Cundinamarca, Colombia, September 1903 (M. de Mathan); and two females from Popayan, Cauca Valley.

I do not find any structural difference between these **females** and *dryas*, and I only place them with *hora* on account of the locality. Perhaps they are *dryas*; but as *hora* is undoubtedly closely allied to *dryas*, the absence of a structural difference in the eighth segment is not surprising.



TEXT-FIG. 16.—*Sychesia hora*, dorsal view.
„ „ 17.— „ „ , ventral view of clasper.
„ „ 18.— „ „ , lateral view of process P¹.
„ „ 19.— „ „ , lateral view of clasper.





TEXT-FIG. 20.—*Sychesia naias*, dorsal view.
" " 21.— " " , ventral view of clasper.
" " 22.— " " , lateral view of processes P^1 and P^2.
" " 23.— " " , anal view of process P^1.

3. **Sychesia naias** spec. nov. (text-figs. 20–23, 42)

If the preceding species, *S. hora*, is the Colombian representative, then *S. naias* must be regarded as replacing it in Central America. Colouring as in *S. hora*; in one of the females a distinct yellow spot in front of the base of vein M^1 (=vein 3) on the hindwing.

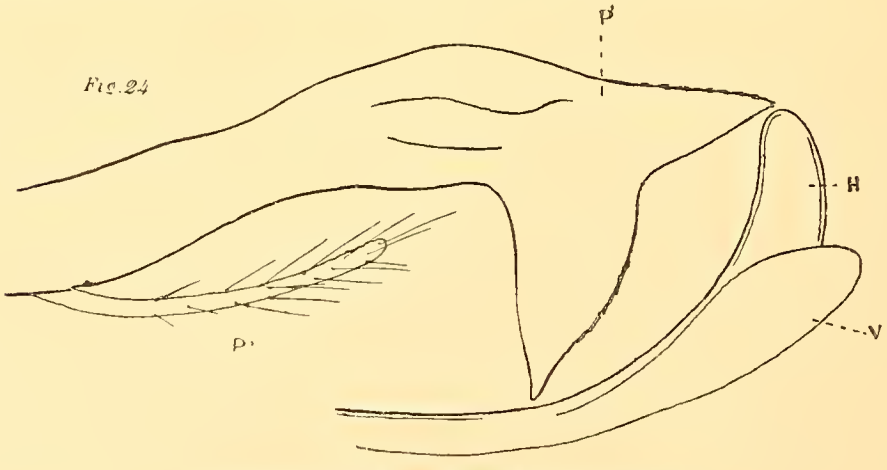
The **male** organs differ as follows: The large process (P^1) of the ninth tergite (text-fig. 20) is apically divided into two lobes, of which the lower one (text-fig. 22) is directed downward, and is curved so much sideways that in a dorsal view (text-fig. 20), its apex projects from under the dorsal lobe. In an anal aspect (text-fig. 23) this ventral lobe somewhat resembles a stocking in shape. The setiferous process (P^2) is thicker than in *hora*. The valve-portion of the side-clasper has entirely disappeared; the harpe (H) ends in two lobes; the outer lobe (L^1) is broad, rounded, and smooth (text-figs. 20, 21), and the inner lobe (L^2) narrow, curved, deeper brown, and bears bristles (as does the corresponding lobe in the other species of *Sychesia*). The apex of the tenth tergite (x. t.) is rather narrower than in the previous species.

In the **female** the eighth sternite has at each side two teeth (text-fig. 42), one being placed at the lateral angle, and the other, which is sometimes small or obtuse, further inward.

We have: one male from Guapiles, Costa Rica, June (W. Schaus), type; three females from Costa Rica (Ch. Underwood); and one female from Rio Wanks, Nicaragua, September 1905 (M. G. Palmer).

4. **Sychesia erubescens** spec. nov. (text-figs. 24, 43)

Besides *S. dryas tupus* there occurs in Santa Catharina a species closely allied to it, but different in colour and structure. This *erubescens* stands about in the same relation to *S. dryas* in the South as *naias* and *hora* in the North.



TEXT-FIG. 24.—*Sychesia erubescens*, lateral view.

A small tuft of scales behind the antenna, the collar, sides of the breast, apices of the coxae, inside of the forecoxa, and the larger portion of the trochanters scarlet,

the abdomen also shaded with scarlet, in the male to a greater and in the female to a lesser extent, the abdominal area of the hindwing, especially in the male, with a distinct red tint.

Larger than *S. dryas*, the fuscous border of the hindwing as broad as in that species, but the fringe from the anal angle to the lower median vein yellow. There is another red-tinted species in Brazil, described below, which has a much narrower terminal band in the male than *erubescens*.

The central prominence of the eighth tergite of the **male** is much smaller than in *S. dryas*. The large process P^1 (text-fig. 24) of the ninth tergite is more compressed distally than in *S. dryas*, and the two lobes into which it is divided (fishtail) are different, the lower being shorter than in *S. dryas*, and the upper one rather longer. The setiferous, slender lobe P^2 projects from the underside of P^1. The side-clasper is very different from that of *S. dryas*. The valve-portion (text-fig. 24, V, lateral aspect) is well developed instead of being reduced to a small tubercle, and the harpe (H) is quite simple, being curved inward apically.

The eighth sternite of the **female** is thicker in the centre than in *S. dryas*, and bears at the lateral angle a very prominent tooth (text-fig. 43).

We have one pair from Santa Catharina.

5. **Sychesia subtilis** Butl. (1878) (text-figs. 25–30, 44)

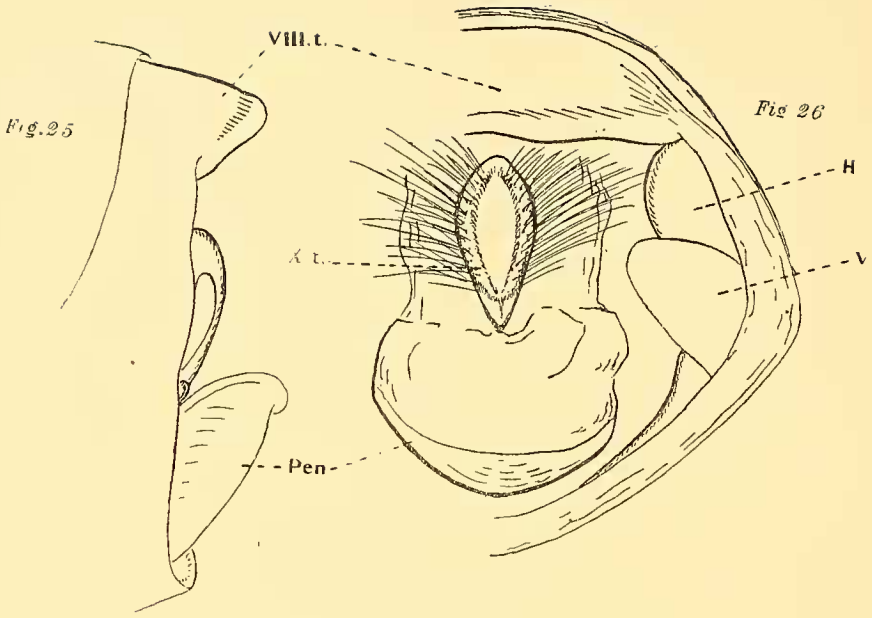
On an average smaller than the preceding species in both sexes; the colouring is the same as in *dryas*, except that the fuscous costal and distal marginal borders of the hindwing, in the male, are narrower and more diffuse both above and below.

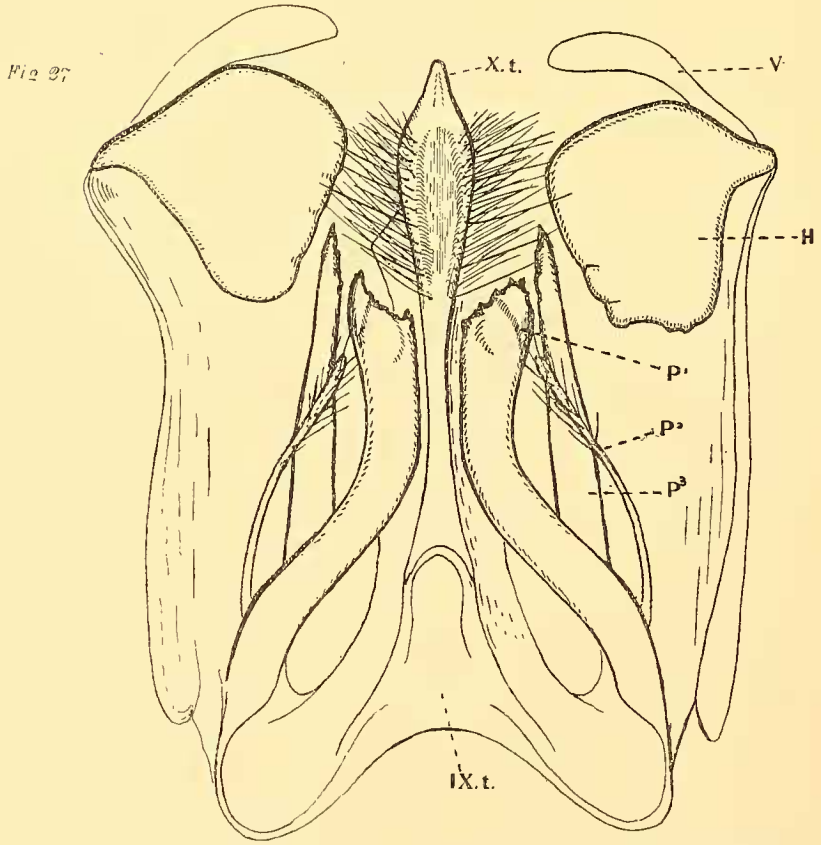
In most specimens the upper angle of the cell of the hindwing projects rather less than in *S. dryas*. The pectinations of the male antenna are distinctly longer than in specimens of *dryas* of the same size, and the distance between the scape and the first pair of pectinations is shorter than in most *S. dryas*.

The genitalia of the **male** are different. The eighth tergite projects much less than in the *S. dryas*, and is less incrassate (text-fig. 25, viii. t.). The ninth tergite has three processes on each side, not two, as in *S. dryas* (text-fig. 27, P^1, P^2, P^3; dorsal view, corresponding to text-fig. 13). The upper process (P^1) is the largest; it is apically widened, but very much less so than in *S. dryas*. P^2 is longer than in *S. dryas*. P^3 arises from the underside of P^1 about its centre, and is straight and pointed.

The feebly chitinised valve (V) is much larger than in *S. dryas*, but still appears as a weak appendage of the harpe, and bears rough scaling. The harpe is large and strongly chitinised (H), the portion most easily seen being a deeply coloured glossy apical lobe which is directed upward. Below this lobe (L^1) the inner margin is sinnate, a second, small lobe (L^2) being formed. The tenth tergite almost agrees with that of *S. dryas*, except that the apex is rather broader and mesally more or less impressed longitudinally.

In the **female** the eighth sternite has not a smooth edge laterally, but is here conspicuously folded and notched, and bears a large pointed tooth at the angle (text-fig. 44).





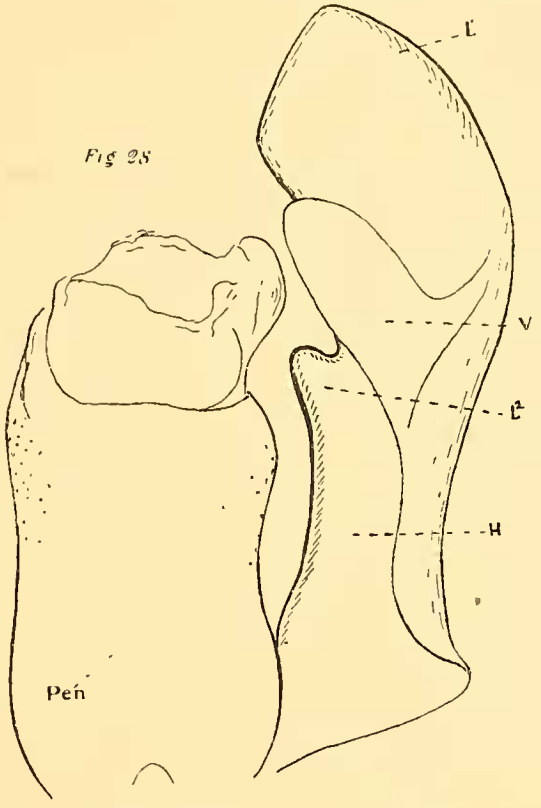
TEXT-FIG. 25.—*Sychesia subtilis megalobus*, lateral view of eighth segment.
„ „ 26.— „ „ „ , anal view of last segments.
„ „ 27.— „ „ „ , dorsal view.

According to the male genitalia there are two geographical forms :

a. *S. subtilis megalobus* subsp. nov. (text-figs. 25–29, 44)

Harpe with a very large apical lobe (text-fig. 29, L^1) ; process P^1 of the ninth segment dorsally convex apically.

A series in the Tring Museum from Aroewarwa Creek, Maroewym Valley,



TEXT-FIG. 28.—*Sychesia subtilis megalobus*, ventral view of clasper and penis-sheath.

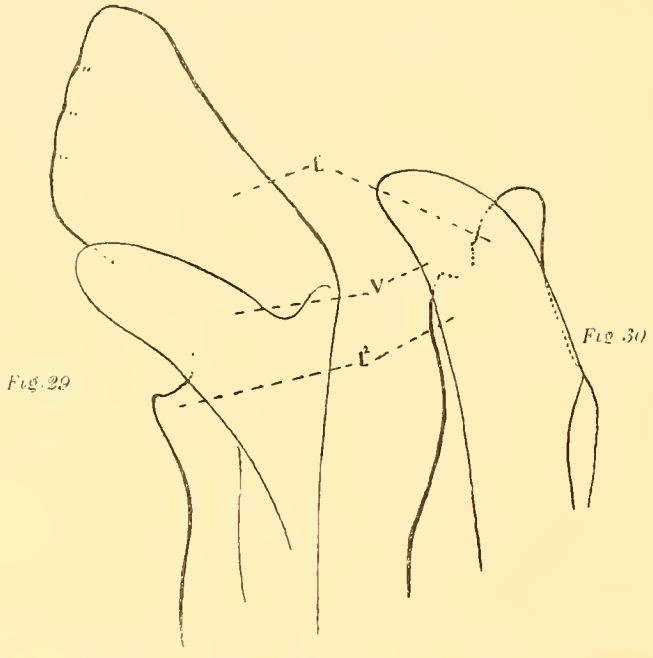
Surinam, February (S. M. Klages), type ; La Union and Guaypa, Canra R., Orinoco, October, November, December, April, May (S. M. Klages) ; Trinidad (F. Birch).

b. *S. subtilis subtilis* Butl. (1878) (text-fig. 30)

Apical lobe of harpe small (text-fig. 30, L^1). Process P^1 of the ninth segment apically compressed ; process P^2 shorter and slenderer than in *megalobus* ; apex of the tenth tergite dorsally more convex.

The type of *subtilis* came from the Rio Sapo, Amazons, caught on December 13, 1874 ; the other specimens mentioned by Butler as far as they are preserved in the British Museum are *S. dryas dryas*, for instance the second Rio Sapo example caught on December 14. As the specimen labelled by Butler "type" is the present insect, the name should be retained for this species, although Hampson has sunk the name as a synonym of *S. dryas*. I cannot find the Rio Sapo ; is Sapo a misspelling of Napo ? In the Tring Museum another male, obtained on board the

steamer on the Amazon between Manacapurei and Teffé at the end of April 1906 (S. M. Klages). This and the type are the only examples I have seen of the Amazonian race. In the type-specimen the lobe of the valve (V) is almost as deep brown as the harpe.



TEXT-FIG. 29.—*Sychesia subtilis megalobus*, ventral view of clasper.
„ „ 30.— „ „ *subtilis*, „ „ „

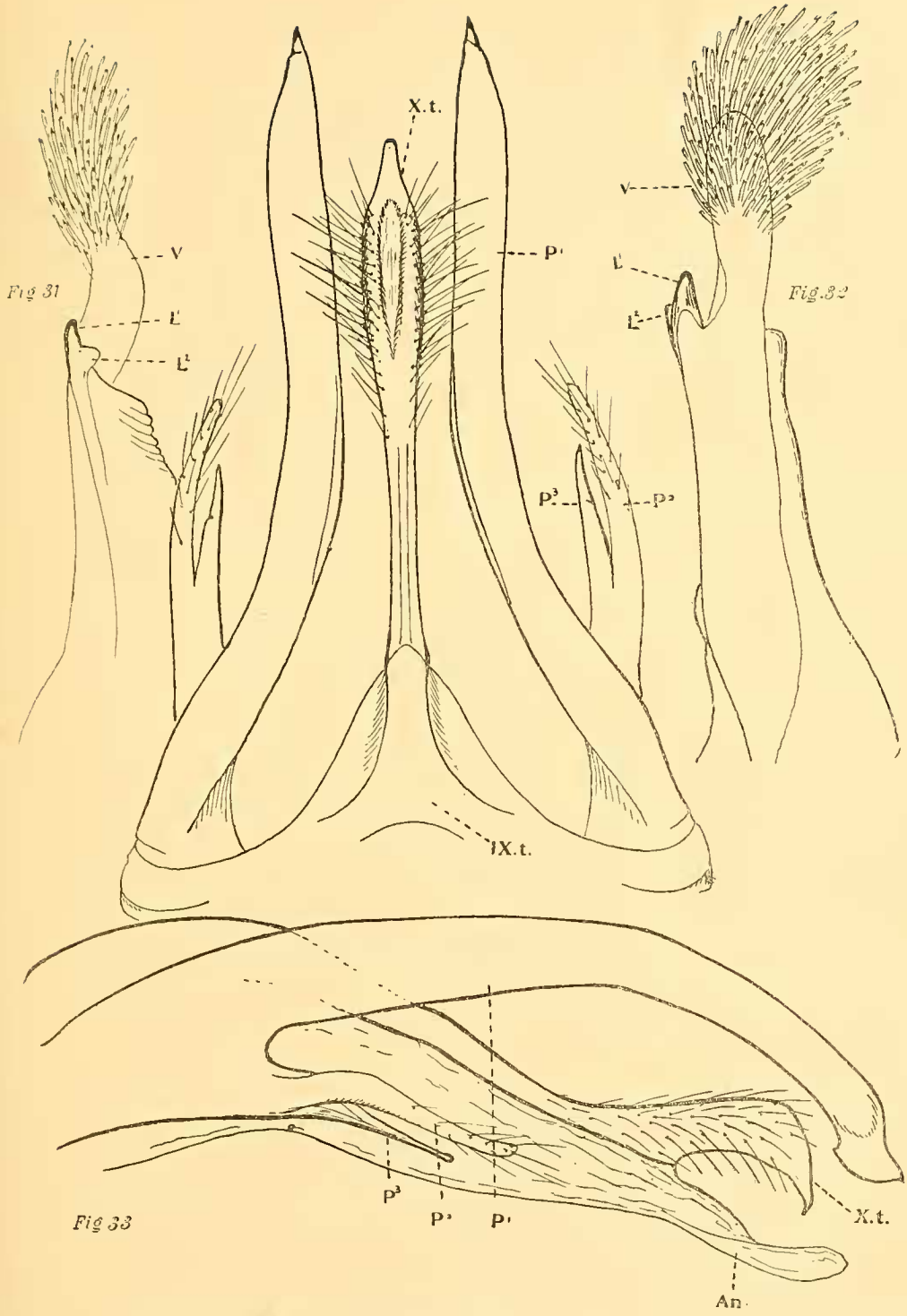
6. Sychesia dimidiata spec. nov. (text-figs. 31–33, 45)

Similar to *dryas* in colour, but the tips of the coxae pure buff-yellow, the yellow area of the hindwing more sharply defined and extending from the base to the lower angle of the cell or only to the point of origin of the upper median branch (type), the area agreeing in size more or less with that of the female of *S. dryas*, except in being deeper yellow.

The ninth tergite of the **male** bears a very long upper process, P^1 (text-fig. 31) and a short, forked, lower process, the two prongs of which are homologous to P^2 and P^3 of *S. subtilis*. Text-fig. 33 represents these organs in a lateral aspect. The valve (V) is long and slender, and the harpe (H) very much smaller than in the previous species, ending in a short lobe (L^1), which bears a tooth on the inner side representing a second lobe (L^2). Only the apical lobe of the harpe is plainly visible, if the long scaling situated at the edge of the eighth segment is removed, L^1 lying inside this segment. The tenth tergite (x. t.) is longer and less curved than in the previous species ; the setiferous apical portion bears a dorsal median groove. The penis-funnel is cylindrical, not flagon-shaped.

We have three males from Mnzo, Rio Cantinero, Colombia, 400 m. (A. H. Fassl).

Two females from Quevedo, West Ecuador, in the Tring Museum possibly belong to this species. The terminal band of the hindwing is somewhat broader than in the male. The edge of the eighth abdominal sternite is thinner in the centre than laterally ; the lateral angle bears a tooth (text-fig. 45).



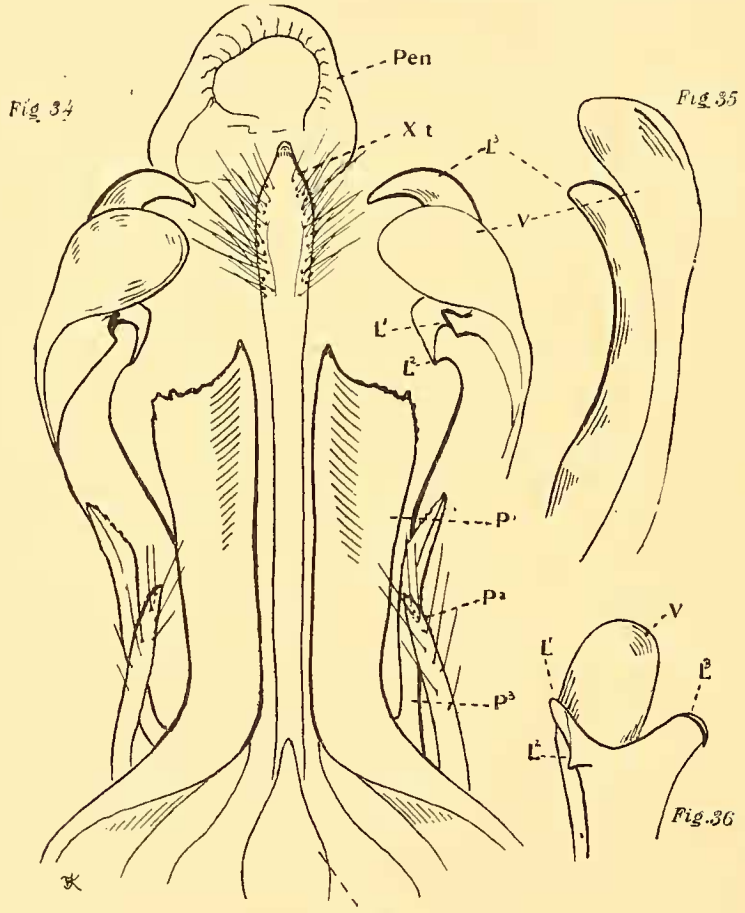
TEXT-FIG. 31.—*Sychesia dimidiata*, dorsal view.
„ „ 32.— „ „ , ventral view of clasper.
„ „ 33.— „ „ , lateral view of ninth and tenth tergites.

An = anus.

7. **Sychesia coccina** spec. nov. (text-figs. 34–36, 46)

In the scarlet tint of the collar, breast, coxae, abdomen and the basi-abdominal area of the hindwing similar to *S. erubescens*. Somewhat smaller than that species, the pectinations of the antenna in the male longer, the scape reddish yellow on the outside, and the terminal border of the hindwing much narrower in the male and broader in the female, than in *erubescens*.

The ninth tergite of the **male** has three processes on each side, as in *S. subtilis*. The large process P^1 is compressed apically and rather strongly curved beyond the



TEXT-FIG. 34.—*Sychesia coccina*, dorsal view.
„ „ 35.— „ „ , ventral view of clasper.
„ „ 36.— „ „ , inner view of clasper.

middle, the apex being dentate and obliquely truncate, with the dorsal angle projecting (text-fig. 34). Process P^2 is stouter than in *subtilis* and P^3 is shorter. The side-claspers are quite different. The valve is well developed (V, text-figs. 34–36), while the lobes of the harpe (H) are small. In a ventral, semilateral aspect (text-fig. 35) the valve and harpe are seen lying side by side, being merged together except the apices, but recognised by the difference in colour and surface-structure. Viewed from this direction only the largest lobe (L^3) of the harpe is visible. In a dorsal view (text-fig. 34) the large lobe (L^3) is much more curved, and below it two

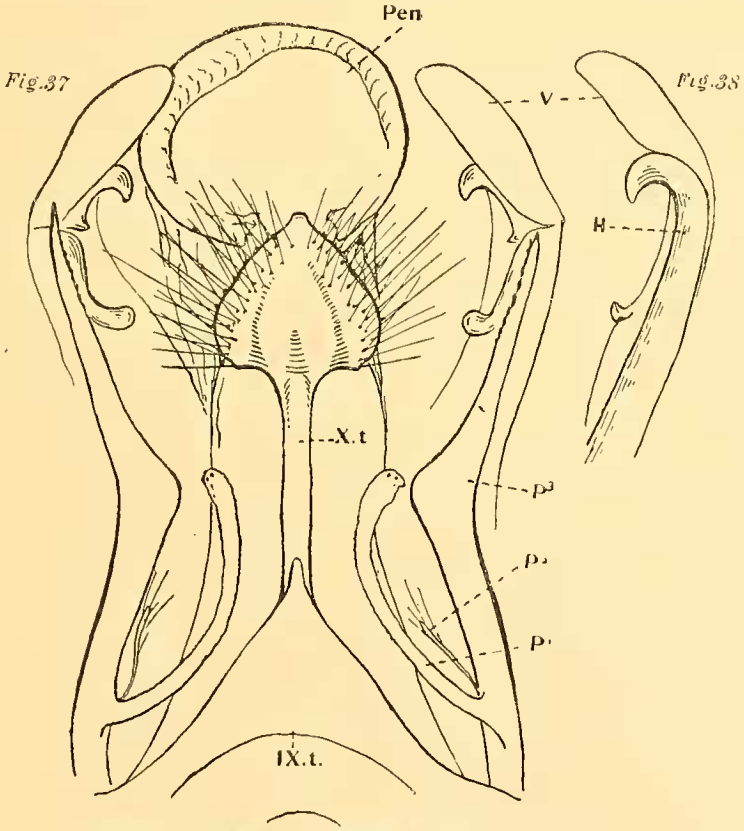
short processes are seen (L^1 and L^2). These are more easily inspected from the inner side (text-fig. 36), the clasper being bent sideways. The three lobes are all strongly chitinised, being red-brown. The tenth tergite resembles that of *S. subtilis*, the tip pointing sharply downwards. The penis-funnel is cylindrical, being slightly widened proximally.

The eighth sternite of the **female** has the edge thicker than in *S. erubescens*, notched in the centre and slightly undulating at each side of the middle. The lateral tooth is conical (text-fig. 46).

We have a pair from Porto Alegre, Rio Grande do Sul. The female recorded by Hampson from the same province, as subsp. 1 of *dryas*, also belongs to *coccina*.

8. **Sychesia pseudodryas** Roths. (1909) (text-figs. 37-38)

Originally described from a single male from La Oroya, South-East Peru; several other specimens were subsequently recorded in *Nov. Zool.* 1910, p. 41, of which the pair from Sta. Catharina is my *erubescens*. On the other hand, the male



TEXT-FIG. 37.—*Sychesia pseudodryas*, dorsal view.
„ „ 38.— „ „ , ventral view of clasper.

mentioned, *l.c.*, under *dryas* from Snno, Upper Rio Napo, belongs to *pseudodryas*. We have now also a male from Sitio, Costa Rica, May (W. Schaus), another from Calama, Rio Madeira, Amazonas, below Rio Machados, August—October 1907 (W. Hoffmanns), and a pair from Teffé, Upper Amazons, October 1912 (Dr. Ducke). These specimens agree closely in structure, and all the males have the terminal

band of the hindwing diffuse; some specimens have no red tint at all, while others have the collar, abdomen, abdominal area of the hindwing and the yellow portions of the breast and coxae more or less tinted with scarlet, like the type-specimen of the name *pseudodryas*. In the female the yellow area of the hindwing is sharply defined, reaching to the point of origin of M^1, being incurved below M^2 and excurved at SM^2, the mummy-brown distal border extending to the abdominal margin.

The eighth tergite of the **male** is thin, in a vertical sense, and not much produced. The ninth tergite has on each side three processes (text-fig. 37). P^1 is very slender, curved upwards and anad, and is, like the very thin setiferous process P^2, a dorsal branch of the main process P^3. The latter is elbowed in the centre, where it is slightly widened, and tapers to the apex, the apical portion of the inner edge being denticulate. In the development of these processes *S. pseudodryas* stands quite isolated. The side-clasper resembles that of *S. coccina* to some extent. The valve (text-fig. 38, V) is well developed, and the harpe (H) bears a small unciform ventral apical lobe and two small lobes farther proximally. The tenth tergite (x. t.) is very characteristic, its apical widened portion being very broad, reversed cordiform, and at least twice as broad as in any of the other species.

The eighth sternite of the **female** resembles that of the females placed above under *S. dimidiata* (text-fig. 45), but the thin central third of its margin is incurved.

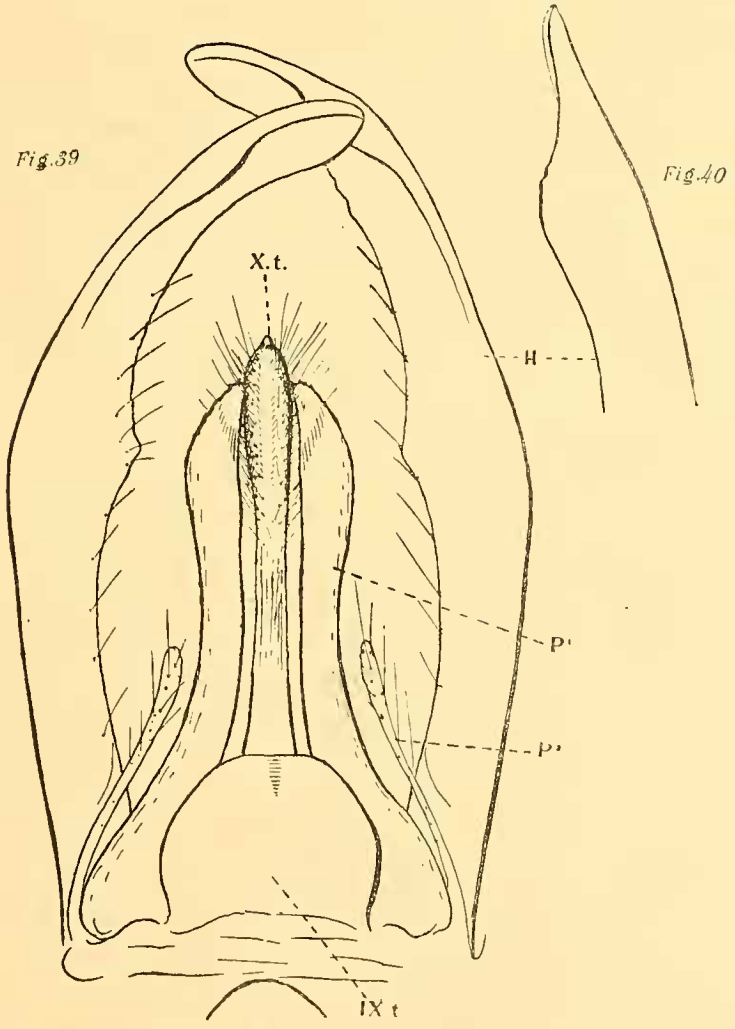
9. **Sychesia omissus** Roths. (1910) (text-fig. 39, 40, 47)

The male is in colour similar to *S. dryas*; the thorax and forewing are usually deeper blackish brown, the collar is red in most examples, and there is occasionally also a reddish tint at the base of the abdomen; the hindwing is, like the abdomen, usually rather deeper yellow than in *dryas*, the distal marginal band posteriorly more sharply defined and here as a rule also broader, and the median branches are more prominently blackish brown. The size varies a great deal, the forewing having a length of from 22 to 31 mm. The pectinations of the antenna are always much shorter than in *dryas*, a difference easily perceived if the two species are placed side by side, while there is no reliance on any of the colour-differences mentioned. The female also has a deeper colour than in most *dryas*.

The genitalia of the **male** are very distinct. The eighth tergite is only slightly produced. The ninth tergite (text-fig. 39) has on each side two processes, the upper one (P^1) being large, curved in the middle and obliquely truncate at the apex; it appears almost straight from the centre to the apex in a dorsal view. P^2 projects from P^1 on the underside. The side-clasper is quite different from that of the other species; it consists of a single, long, curved, strongly chitinised sclerite which tapers at the apex (text-figs. 39, 40). The two claspers cross one another beneath the eighth tergite, and are visible without dissection on account of their great length. The tenth tergite (x. t.) is essentially as in *S. dryas*, only the widened apical portion being rather longer. The genitalia are neither individually nor geographically quite constant.

The two **females** which I place here differ very little from *dryas*. The margin of the eighth tergite is less convex in the centre, and the lateral angles bear a tooth (text-fig. 47). Considering the great difference in the claspers between *S. dryas* and *omissus*, one would have expected to find a trenchant distinction between the females as well.

We have this species from: Aroewarwa Creek, Maroewym Valley, Surinam, February 1905 (S. M. Klages), 1 ♂; La Union and Guaypa, Caura R., Orinoco, March and April 1902, September—October, 1901, November—December, 1902 (S. M. Klages), 11 ♂♂, 11 ♀♀; Oxapampa, Peru, 1♂ (type); Chanchamayo, Peru, October 1901 (Garlepp), 1 ♂; Huancabamba, Huánuco, Peru (E. Böttger), 5 ♂♂; S. Domingo, Tinguri, R. Huacamayo, and La Oroya, Carabaya, South-East Peru, 6000 ft., 3400 ft., and 3100 ft. respectively (G. R. Ockenden), nearly



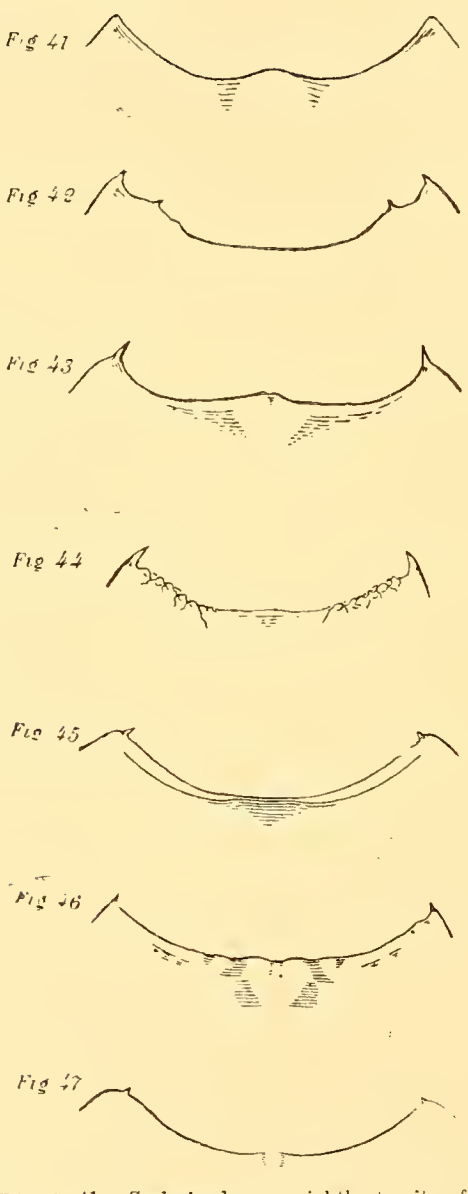
TEXT-FIG. 39.—*Sychesia omissus*, dorsal view.
„ „ 40.— „ „ , ventral view of apex of clasper.

all the year round, 17 ♂♂, 1♀; Salampioni, Bolivia, 800 m., August 1901 (Simons), 1 ♂; Yungas de Coroica, Bolivia (Garlepp), 1 ♂.

The other specimens mentioned under *omissus* in *Nov. Zool.* 1910, p. 41, do not belong to this species.

The distribution of *S. omissus* is essentially the same as that of *S. dryas dryas*. The type-specimen is labelled Oxapampa, N. Peru; it was received from a German dealer, and I presume that the name is meant for Oxabamba in the province of

Huánuco, to the east of Cerro de Pasco. The collector probably was a Saxon, pronouncing p as b and b as p.



TEXT-FIG. 41.—*Sychesia dryas*, eighth sternite of ♀.
" " 42.— " *naias*, " " "
" " 43.— " *erubescens*, " " "
" " 44.— " *subtilis* " " "
" " 45.— " *dimidiata*, " " "
" " 46.— " *coccina*, " " "
" " 47.— " *omissus*, " " "

On the preceding pages I have dealt with insects corresponding to two species of the *Lep. Phal.* of Hampson, *Ammalo insulata* and *Sychesia dryas* (as *Elysius dryas* in Hampson). We have seen that under the garb of *insulata* three species are concealed, and that there are nine species of *Sychesia* instead of one (Hampson, *dryas*)

or three (Rothschild, *dryas*, *pseudodryas* and *omissus*). The conclusion to be drawn from the results of our investigation is obviously this : In order to arrive, without evidence from breeding, at fairly accurate systematics it is insufficient to study only the external aspect of the specimens. A cataloguer, however, who has to cover the ground at a rapid pace, cannot be expected to spend his time in tedious and minute investigations. That is a matter for a specialist. The scientific study of Lepidoptera, unfortunately, has not yet arrived at such a state of development that there is a sufficiency of specialists supplementing the army of general lepidopterists. It would therefore be of great advantage if the lepidopterist, after having acquired a general knowledge of the order, concentrated his efforts on a single family or a branch of a family. Here he can do substantial systematic work absolutely necessary for our understanding of nature. If I thus plead for specialisation, I do not wish to say a word against the collector who gathers the specimens for the sake of the pleasure they give him, nor against the lepidopterist who is made happy by the receipt of new species which he can name. Their efforts are a great asset in science, although there have been, and there are still, members of the scientific world who pour cheap satire on them. The very pleasure which the collector derives from the products of nature, and the communion into which he enters with nature when contemplating and comparing the species and pondering over their habits and life-history, are of such high aesthetic value in our neurasthenic times that from this point of view even, quite apart from any incidental contribution to science pure or applied, the occupation with nature's products should be greatly encouraged in a nation. Who would call it accidental that there are so many more collectors of insects among the truly progressive nations than among the others? I am not pleading against the collector pure and simple, the man who is brought in close touch with nature and is the happier for it. There are, however, many among them who could achieve more, many who have the knowledge, the time and the opportunity. It is the inclination to concentrate their efforts and deepen them which is missing ; and to awaken this inclination wherever it may be dormant and to foster it wherever it has begun to stir, I should, if I could, paint in glowing terms the need for specialisation and a morphological treatment of the Lepidoptera.

A second point quite clearly demonstrated by the foregoing pages is this: Specimens of the various species, or of most of them at any rate, have been in the hands of lepidopterists and not been recognised as belonging to different species, and I have stated over and over again that the external differences are, in nearly every case here dealt with, quite unreliable. If that is so, could these species be recognised from coloured drawings only? Certainly not. Therefore the dictum of my friend Charles Oberthür, that no name is valid which is not accompanied by a good figure, does not cover all cases. If any such proposal could ever be adopted—the proposal certainly draws attention to a weak spot in descriptive entomology, and will exercise a good influence whether officially adopted or not—we must replace "a good figure" by "a figure sufficient for the determination of the species or variety." Such a practice in nomenclature, however, would invalidate many names which are accompanied by "good" figures, these figures not showing any of those details in structure by which alone the particular species can be recognised, structures of which neither the author who named the species nor the artist who made a drawing of it had taken cognizance.

The differences between the species above described being essentially such

as are not visible outwardly, the specific distinguishing characters cannot have developed by means of selection on the part of insectivorous enemies.

In some of the species we find small but obvious morphological differences in the specimens from certain localities: geographical varieties or **subspecies.** In other forms which are also geographically separated the differences are so great that we must consider them specific; these species replace one another, one being a substitute for the other: **vicariant species.** And lastly, we have species the ranges of which overlap or are more or less the same, the species occurring side by side, often actually flying together: **synpatric species.** This gradation in the evolution is represented, for instance, by (1) *Sychesia dryas dryas* and *S. dryas tupus*, which exclude one another geographically, but are essentially the same insect; (2) *Ammalo insulata*, *A. arravaca* and *A. aurata*, which also inhabit separate geographical areas, but are so different that they might occur together without mixing and amalgamating; and (3) *Sychesia dryas*, *S. subtilis* and *S. omissus*, which occur together. If the differences in the first category become greater, we have the second. If the range of the second category extends, we have the third category of forms. This is true not only for insects, but also for other classes of animals, the exceptions appearing to me more seeming than real. The important part which geographical isolation plays in the evolution of the subspecies and vicariant species is so obvious that it is hardly necessary to dilate on it. Which, however, is the factor or group of factors that led to the appearance of the structural differences we have described? Mendelism cannot account for the geographical phenomenon embodied in the problem; selection by insectivorous enemies being likewise excluded, there remains the influence of the anorganic surroundings, which are different in the various geographical areas, in connection with geographical isolation. If the geology of a continent or archipelago is known, i.e. the relative ages of the districts or islands, one can generally predict with a high degree of accuracy where subspecies and vicariant species will be found.

I have assumed that the various species of *Sychesia*, and the three yellow *Ammalo*, have retained the colouring of the respective ancestors from which they are derived, and for this reason are externally so similar to one another. The opinion, however, might be advanced that these species were originally also different in colouring, and their present synchromatism is a secondary development due to mimicry. This cannot be a true explanation, because (1) most of the species are not synpatric, and (2) the subspecies of *S. dryas* and *S. subtilis* are alike in colour and different in structures in a similar way as are the species, but to a much lesser degree.